

PRE-FORMED CONCRETE SECTION

FIELD OF THE INVENTION

5 This invention relates to an apparatus and method for making a pre-formed concrete section.

BACKGROUND OF THE INVENTION

10 Pre-formed concrete sections are used in the construction industry to simplify and economize the building process. These pre-formed sections are often formed at a remote location away from a building site, and then shipped to the building site to be installed in the structure. One example of a pre-formed section is a concrete section commonly referred to as a "double-tee." A double-tee generally includes a flat deck and two support beam legs extending below the deck. The section is called a double-tee because the cross-sectional view of the section resembles two T's connected side-by-side. A double-tee may
15 often be used to construct parking ramps, bridges, floors, or other structures that may require a relatively strong and durable surface and a large amount of usable surface area. For example, in a parking ramp, the double tee may support the weight of several cars parked on top of the double-tee.

SUMMARY OF THE INVENTION

20 The present invention provides a pre-stressed concrete section comprising a deck and first and second legs extending from the deck. The deck includes a first side, a second side opposite the first side, and a width extending between the first and second sides. The deck also includes a top surface, a bottom surface opposite the top surface, and a thickness
25 extending between the top and bottom surfaces. The width of the deck may include quarter points that divide the width of the deck into four equal segments. In some aspects and in some constructions, the width of the deck may be about 18 feet.

The first and second legs project from the bottom surface of the deck. The legs are not positioned at the quarter points along the width of the deck. The width of the deck
30 may include a midpoint disposed about equidistant from each side of the deck, and a cross-section of the concrete section may be substantially symmetrical about the midpoint. The distance from the first leg to the second leg is more than two times greater than the distance from the first side to the first leg. In some aspects and in some constructions, the

distance from the first leg to the second leg may be more than three times greater than the distance from the first side to the first leg. The width of the deck from the first side to the second side is more than four times greater than the distance from the first side to the first leg.

5 In some aspects and in some constructions, the deck comprises a first outer portion extending from the first leg toward the first side and a second outer portion extending generally from the second leg toward the second side. The thickness of the deck from the top surface to the bottom surface may decrease as the first outer portion extends outwardly from the first leg toward the first side. The thickness of the deck from the top surface to
10 the bottom surface may decrease as the second outer portion extends outwardly from the second leg toward the second side. The thickness of the deck may decrease at a relatively constant rate as the first and second outer portions extends outwardly from the first and second leg, respectively, toward the first and second side, respectively.

 In some aspects and in some constructions, the deck comprises a central portion
15 disposed between the first and second legs, a first inner portion extending between the first leg and the central portion of the deck, and a second inner portion extending between the second leg and the central portion of the deck. The thickness of the deck may remain substantially constant as the central portion extends along at least a portion of the width of the deck. The thickness of the deck may decrease as the first inner portion extends
20 inwardly from the first leg toward the central portion. The thickness of the deck may decrease as the second inner portion extends inwardly from the second leg toward the central portion.

 In some aspects and in some constructions, a platform, or concrete section assembly, may be formed by having at least two sections connected to one another. The
25 decks of each connected section are substantially co-planar and the second side of the deck of a first section is connected to the first side of the deck of a second section adjoining the first section. The distance from the first leg to the second leg of the first section is greater than the distance from the second leg of the first section to the first leg of the second section adjoining the first section. Therefore, the legs are unevenly spaced across the
30 platform.

 Independent features and independent advantages of the present invention will become apparent to those skilled in the art upon review of the following detailed description, claims and drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 is an end view of a pre-formed concrete section embodying aspects of the invention.

5 Fig. 2 is a reduced bottom view of the concrete section of Fig. 1.

Fig. 3 is a side view of the concrete section of Fig. 2.

Fig. 4 is an enlarged view of a flange portion of the concrete section of Fig. 1.

Fig. 5 is an end view of an assembly of multiple concrete sections illustrated in Fig. 1.

10 Fig. 6 is an enlarged view of a portion of the concrete section of Fig. 1 with portions broken away.

Fig. 7 is an end view of an alternative embodiment of this invention and including a pre-formed concrete section embodying aspects of the invention.

15 Before any embodiments of the invention are explained in detail, it is to be understood that the invention is not limited in its application to the details of construction and the arrangements of components set forth in the following description or illustrated in the drawings. The invention is capable of other embodiments and of being practiced or of being carried out in various ways. Also, it is to be understood that the phraseology and terminology used herein is for the purpose of description and should not be regarded as
20 limiting.

Although references may be made below to directions, such as left, right, up, down, top, bottom, front, rear, back, etc., in describing the drawings, these references are made relative to the drawings (as normally viewed) for convenience. These directions are not intended to be taken literally or limit the present invention in any form.

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DETAILED DESCRIPTION

Fig. 1 illustrates a pre-stressed concrete section 10 comprising a deck 14 and a first leg 18 and a second leg 22 projecting from the deck 14. In the illustrated construction, the concrete section 10 includes a form of pre-stressed concrete commonly referred to as a
30 "double-tee". As shown in Figs. 1-3, the deck 14 includes a first end 26, a second end 30 opposite the first end 26, and a length (L) extending between the first and second ends 26, 30. In the illustrated construction, the length (L) of the deck 14 is about 61 feet. The deck 14 includes a first side 34, a second side 38 opposite the first side 34, and a width (W)

extending between the first and second sides 34, 38. In the illustrated construction, the width (W) of the deck 14 is about 18 feet. The deck 14 includes a top surface 42, a bottom surface 46 opposite the top surface 42, and a thickness (T) extending between the top and bottom surfaces 42, 46. In the illustrated construction, the top surface 42 of the deck 14 generally lies in a single place. The thickness (T) of the deck 14 may vary, as described below.

The first leg 18 and the second leg 22 project from the bottom surface 46 of the deck 14 and each leg 18, 22 extends substantially along the entire length (L) of the deck 14. As shown in Fig. 1, the legs 18, 22 are tapered as they extend away from the deck 14. In the illustrated construction, the legs 18, 22 extend to a distance of about 2 feet 10 inches from the top surface 42 of the deck 14. The legs 18, 22 have a width of about 8 inches near the intersection of the legs 18, 22 and the bottom surface 46 of the deck 14, and a width of about 5.25 inches near the end of the legs 18, 22 opposite the deck 14. In the illustrated construction, the cross-sectional area of the section 10 remains substantially constant as the section 10 extends along the length (L).

It is of course understood that the listed dimensions and measurements described in the specification are illustrative only and that the overall size and dimensions of the deck 14 and legs 18, 22 and their pertinent structures will be selected to accommodate the loads and operational conditions and applications in which the section 10 will be utilized.

The deck 14 includes a first outer portion or flange 50, a second outer portion or flange 54, a central portion 58, a first inner portion 62, and a second inner portion 66. The first outer portion or flange 50 extends outwardly from the first leg 18 toward the first side 34 and extends substantially along the entire length (L) of the deck 14. In some aspects and in some constructions, the thickness (T) of the deck 14 generally decreases as the first outer portion 50 extends outwardly from the first leg 18 toward the first side 34. The thickness (T) of the deck 14 remains substantially constant as the first outer portion 50 extends along the length (L) of the deck 14. In the illustrated construction, the thickness (T) of the deck 14 decreases at a relatively constant rate as the first outer portion 50 extends outwardly from the first leg 18 toward the first side 34, such that the portion or flange 50 is tapered toward the edge. The top surface 42 of the portion or flange 50 remains co-planar with the remainder of the deck 14. In the illustrated construction, the thickness (T) of the deck 14 is about 3.25 inches at the intersection of the first outer

portion 50 and the first leg 18 and decreases to about 1.75 inches at the first side 34. The width of the first outer portion 50 is about 3 feet 2 inches.

The second outer portion or flange 54 extends from the second leg 22 toward the second side 38 and extends along the length (L) of the deck 14. In the illustrated construction, the second outer portion 54 is substantially a mirror image of the first outer portion 50. In some aspects and in some constructions, the thickness (T) of the deck 14 generally decreases as the second outer portion 54 extends outwardly from the second leg 22 toward the second side 38. The thickness (T) of the deck 14 remains substantially constant as the second outer portion 54 extends along the length (L) of the deck 14. In the illustrated construction, the thickness (T) of the deck 14 decreases at a relatively constant rate as the second outer portion 54 extends outwardly from the second leg 22 toward the second side 38. In the illustrated construction, the thickness (T) of the deck 14 is about 3.25 inches at the intersection of the second outer portion 54 and the second leg 22 and decreases to about 1.75 inches at the second side 38. The width of the second outer portion 54 is about 3 feet 2 inches.

The central portion 58 is disposed between the first and second legs 18, 22 near the middle of the deck 14. The central portion 58 extends along a portion of the width (W) of the deck 14 and substantially along the entire length (L) of the deck 14. In some aspects and in some constructions, the thickness (T) of the deck 14 remains substantially constant as the central portion 58 extends along the width (W) and the length (L) of the deck 14. In the illustrated construction, the thickness (T) of the deck 14 is about 2.25 inches across the central portion 58. The width of the central portion 58 across the deck 14 is about 8 feet 8 inches from the edge of the first inner portion 62 to the edge of the second inner portion 66.

The first inner portion 62 extends inwardly from the first leg 18 toward the central portion 58 and substantially along the entire length (L) of the deck 14. In some aspects and in some constructions, the thickness (T) of the deck 14 decreases as the first inner portion 62 extends inwardly from the first leg 18 toward the central portion 58. The thickness (T) of the deck 14 remains substantially constant as the first inner portion 62 extends along the length (L) of the deck 14. In the illustrated construction, the thickness (T) of the deck 14 decreases at a relatively constant rate as the first inner portion 62 extends inwardly from the first leg 18 toward the central portion 58. In the illustrated construction, the thickness (T) of the deck 14 is about 3.25 inches at the intersection of the

first inner portion 62 and the first leg 18 and decreases to about 2.15 inches at the intersection of the first inner portion 62 and the central portion 58. The width of the first inner portion 62 is about 10 inches.

5 The second inner portion 66 extends from the second leg 22 toward the central portion 58 and substantially along the entire length (L) of the deck 14. In some aspects and in some constructions, the thickness (T) of the deck 14 decreases as the second inner portion 66 extends inwardly from the second leg 22 toward the central portion 58. The thickness (T) of the deck 14 remains substantially constant as the second inner portion 66 extends along the length (L) of the deck 14. In the illustrated construction, the thickness
10 (T) of the deck 14 decreases at a relatively constant rate as the second inner portion 66 extends from the second leg 22 toward the central portion 58. In the illustrated construction, the thickness (T) of the deck 14 is about 3.25 inches at the intersection of the second inner portion 66 and the second leg 22 and decreases to about 2.15 inches at the intersection of the second inner portion 66 and the central portion 58. The width of the
15 second inner portion 66 is about 10 inches.

In the illustrated construction, the top surface 42 of the deck 14 is substantially coplanar across the first outer portion or flange 50, the second outer portion or flange 54, the central portion 58, the first inner portion 62, and the second inner portion 66. However, the bottom surface 46 of the deck 14 may not be coplanar across these portions 50, 54, 58,
20 62, 66. The thickness (T) from the top surface 42 to the bottom surface 46 may vary across these portions 50, 54, 58, 62, 66.

In Fig. 1, the first and second outer portions or flanges 50, 54 are cantilevered outwardly from the first and second legs 18, 22, respectively. The outer portions or flanges 50, 54 are tapered as they extend outwardly. The decreasing thickness (T) of the
25 deck 14 at the first and second outer portions 50, 54 permits the cantilevered outer portions 50, 54 to adequately support weight on the top of the deck 14. This distance of the outer portions 50, 54 from the legs 18, 22 provides additional surface area for the deck 14 beyond the legs 18, 22 and also provides adequate strength to hold the weight supported by the section 10. The position of the legs 18, 22 relative to the deck permits the section
30 10 to have a relatively large width (W). The central portion 58 extends between the legs 18, 22 to provide additional surface area on the deck 14.

In Fig. 1, a first distance D1 represents the distance, in a direction substantially parallel to the deck 14, from the first side 34 to the center of the first leg 18. A second

distance D2 represents the distance, in a direction substantially parallel to the deck 14, from the center of the first leg 18 to the center of the second leg 22. A third distance D3 represents the distance, in a direction substantially parallel to the deck 14, from the center of the second leg 22 to the second side 38.

5 In the illustrated construction, the overall width (W) of the deck 14 is about 18 feet. In the illustrated construction, the first and second distances D1, D2 are approximately the same and are about 3.5 feet. The first distance D1 generally represents the width of the first outer portion 50, and the third distance D3 generally represents the width of the second outer portion 54. In the illustrated construction, the second distance D2 is about 11
10 feet. The second distance D2 generally represents the combined width of the central portion 58, the first inner portion 62, and the second inner portion 66.

 In the illustrated construction, the second distance D2 is more than two times greater than the first distance D1. Similarly, the first distance D1 is less than $\frac{1}{4}$ of the overall width (W) of the deck 14, and the first and second legs 18, 22 are positioned at less
15 than $\frac{1}{4}$ of the overall width (W) of the deck 14 from the respective first and second sides 34, 38. In addition, the second distance D2 between the first and second legs 18, 22 is greater than half the overall width (W) of the deck 14. In the illustrated construction, the second distance D2 is more than three times greater than each of the first distance D1 and the second distance D2. The second distance D2 is generally between two and four times
20 greater than the first distance D1. This spacing of the legs 18, 22 relative to the deck 14 provides additional surface area on the deck 14 while providing adequate strength for the load supported by the deck 14.

 As shown in Fig. 2, the section 10 includes multiple weldments 70 connected to the first and second sides 34, 38 of the deck 14 and spaced along the length (L) of the deck 14.
25 The weldments 70 are generally used to connect the section 10 to other sections and form an assembly of sections having a large usable surface. Fig. 4 illustrates an enlarged view of a flange portion of the deck 14. In Fig. 4, the weldment 70 is connected to the first side 34 and extends into the first outer portion 50 of the deck 14. The weldment 70 includes an elongated bent metal strip having a central plate exposed from the concrete and arms
30 diverging from the central plate and embedded within the concrete of the deck 14. An example of the weldment 70 is disclosed in U.S. Patent No. 5,402,616, the entire contents of which are incorporated herein by reference. The sections 10 are generally positioned side-by-side and the weldments 70 on the adjoining sections may be connected by welding

the weldments 70 from the sections to one another, or other similar joining means, such as bolts.

Fig. 5 illustrates an example of a platform 74 comprising an assembly of multiple pre-stressed concrete "double-tee" sections 10 joined side-by-side. In Fig. 5, each concrete section 10 is substantially the same as the section 10 described above. The second side 38 of each section 10 may be connected to the respective first side 34 of an adjoining section 10, and the decks 14 of each section 10 combine to form a single surface of the platform 74.

As shown in Fig. 5, the platform 74 has uneven leg spacing across the platform 74. As described above, the second distance D2 represents the distance between the center of the first leg 18 and the center of the second leg 22. In Fig. 5, a fourth distance D4 represents the distance between the center of the second leg 22 of one section 10 and the center of the first leg 18 of an adjoining section 10. Since the respective sides 38, 34 of the sections 10 are connected, the fourth distance D4 is essentially the sum of the first distance D1 (Fig. 1) and the third distance D3 (Fig. 1), as described above and shown in Fig. 1. In addition, the sum of the second distance D2 and the fourth distance D4 is substantially the same as the overall width (W) of the deck 14.

Since the first distance D1 (Fig. 1) and the third distance D3 (Fig. 1) are substantially the same, the fourth distance D4 is approximately twice as large as either the first distance D1 (Fig. 1) or the third distance D3 (Fig. 1) individually. As described above, the second distance D2 is more than two times greater than either the first distance D1 (Fig. 1) or the third distance D3 (Fig. 1). Therefore, the second distance D2 is greater than the fourth distance D4 because the second distance D2 is more than twice as large as either the first distance D1 (Fig. 1) or the third distance D3 (Fig. 1). In the illustrated construction, the second distance D2 is about 1.5 times greater than the fourth dimension D4, with the second distance D2 being about 11 feet and the fourth distance being about 7 feet. In some aspects and in some constructions, the second distance D2 may be between one and two times greater than the fourth distance D4.

Positioning the legs at the quarter points of the deck would provide generally uniform spacing of the legs across the platform, or adjoining sections. The quarter points generally represent one quarter of the distance across the width (W) of the deck 14. Fig. 1 shows a first quarter point Q1, a second quarter point Q2, and a third quarter point Q3. The distance from the first side 34 to the first quarter point Q1 is about $\frac{1}{4}$ of the overall

width (W) of the deck 14. The distance from the second side 38 to the third quarter point Q3 is also about $\frac{1}{4}$ of the overall width (W) of the deck 14. For example, in a section in which the legs are positioned at the quarter points, such as Q1 and Q3, the distance between legs of each single section would be the same as the distance from the leg of one section to the nearest leg of a second section. Therefore, the legs would be evenly spaced across a platform having multiple sections. However, this is not the configuration of the illustrated section 10 and platform 74.

As shown in Figs. 1 and 5, the legs 18, 22 are positioned closer to the relative sides 34, 38 than the quarter points Q1, Q3. The legs 18, 22 generally function as support beams, and the uneven spacing of the legs 18, 22 across the platform 74 varies how the weight supported by the platform is distributed over the outer portions 50, 54 outside of the legs 18, 22 and the central and inner portions 58, 62, 66 between the legs 18, 22 of each section 10. The uneven spacing also provides adequate support for the cantilevered outer portions 50, 54 and permits the legs 18, 22 to be spaced further apart from one another to provide a wider deck 14 having additional surface area in comparison to some prior art double-tee sections.

Fig. 6 illustrates an enlarged view of the first end 26 of the deck 14. The end 26 may include connectors to connect the section 10 to a support wall, a beam, the respective end of another section, or other similar support structures.

Fig. 7 illustrates another construction of a pre-stressed concrete section 110. The section 110 is similar to the section 10, described above. The section 110 includes a deck 114 and a first leg 118 and a second leg 122 projecting from the deck 114. The deck 114 includes a first side 134, a second side 138 opposite the first side 134, and a width (W) extending between the first and second sides 134, 138. The deck 114 includes a top surface 142, a bottom surface 146 opposite the top surface 142, and a thickness (T) extending between the top and bottom surfaces 142, 146.

In some aspects and in some constructions, the thickness (T) of the deck 114 is substantially the same across the width (W) of the deck 114. The thickness (T) of the deck 114 remains substantially constant as the deck 114 extends outwardly from the first leg 118 toward the first side 134. Similarly, the thickness (T) of the deck 114 remains substantially constant as the deck extends outwardly from the second leg 122 toward the second side 138. The thickness (T) of the deck 114 also remains substantially constant as the deck 114 extends between the first and second legs 118, 122. As shown in Fig. 7, the

top surface 142 is substantially co-planar across the width (W) of the deck 114, and the bottom surface 146 is also substantially co-planar across the width (W) of the deck 114.

In Fig. 7, the legs 118, 122 of the section 110 are positioned at substantially the same position relative to the deck 114 as the legs 18, 22 in the previous section 10 are positioned relative to the deck 14, described above and shown in Figs. 1-5. In Fig. 7, the first distance D1, in a direction substantially parallel to the deck 114, from the first side 134 to the center of the first leg 118 is substantially the same as the third distance D3 from the center of the second leg 122 to the second side 138. The second distance D2 from the center of the first leg 118 to the center of the second leg 122 is more than two times greater than either the first distance D1 or the third distance D3. In some aspects and in some constructions, the second distance D2 may be between two and four times greater than either the first distance D1 or the third distance D3. In the illustrated construction, the second distance D2 is actually slightly more than three times greater than either the first distance D1 or the second distance D2. In addition, the second distance D2 is greater than half the overall width (W) of the deck 114.

Similarly, the first distance D1 is less than $\frac{1}{4}$ of the overall width (W) of the deck 114, and the first and second legs 118, 122 are positioned at less than $\frac{1}{4}$ of the overall width (W) of the deck 114 from the respective first and second sides 134, 138. This spacing of the legs 118, 122 relative to the deck 114 provides additional surface area on the deck 114 while providing adequate strength for the load supported by the deck 114. As described above, when the distance from each leg 118, 122 to each respective side 134, 138 is less than $\frac{1}{4}$ of the overall width (W) of the deck 114 from the respective sides, the spacing between the legs 118, 122 is uneven when multiple sections 110 are connected by their sides 134, 138.

It is of course understood that the listed dimensions and measurements described in the specification are illustrative only and that the overall size and dimension of the section 10 and its pertinent structures will be selected to accommodate the loads and operational conditions in which the section 10 will be utilized.

The foregoing detailed description describes only a few of the many forms that the present invention can take, and should therefore be taken as illustrative rather than limiting. It is only the claims, including all equivalents that are intended to define the scope of the invention.